PLUME STRUCTURES IN THE CENTRAL ALEUTIAN BASIN

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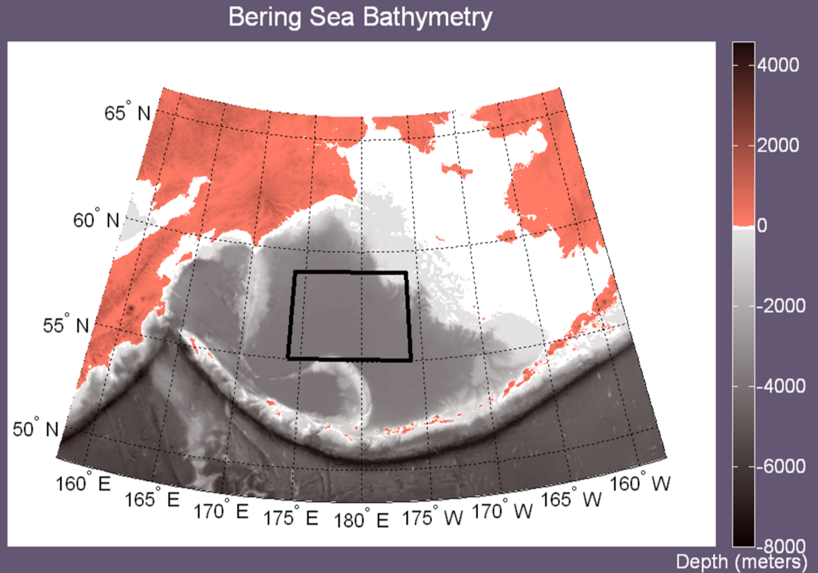
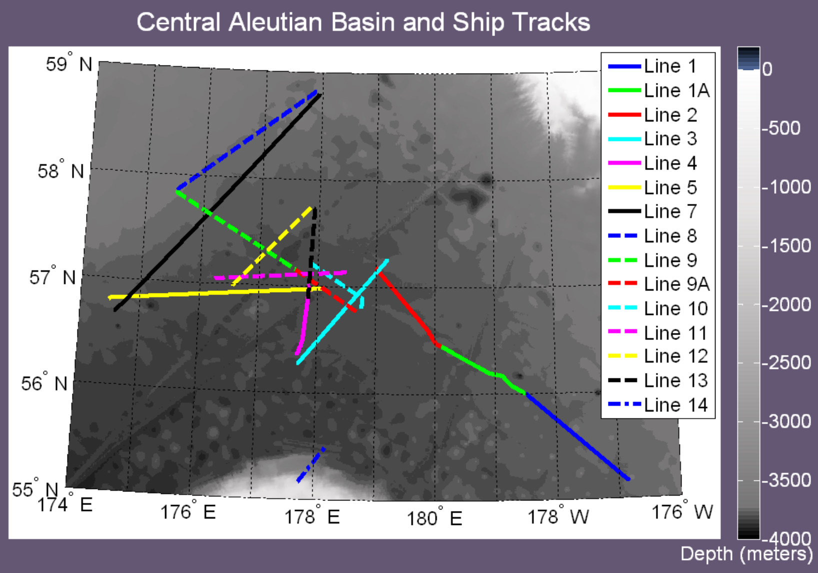
Introduction





- The Aleutian Basin is a deep ocean basin located in the Bering Sea.

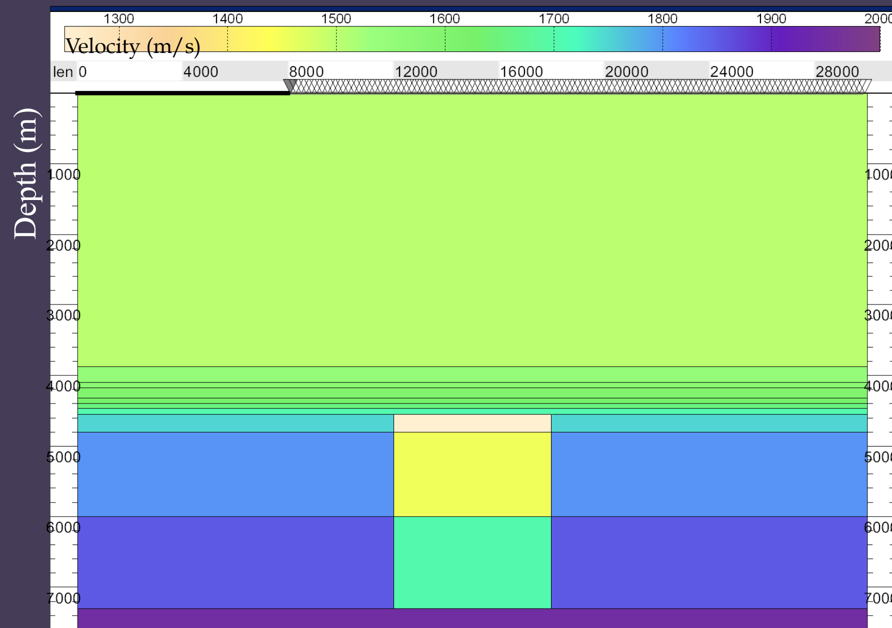
- Unique due to its potential for gas hydrates.
  - Temperature and pressure
  - Influx of organic sediment: uncommon for a deep ocean basin
  - Very flat-lying, regular geology

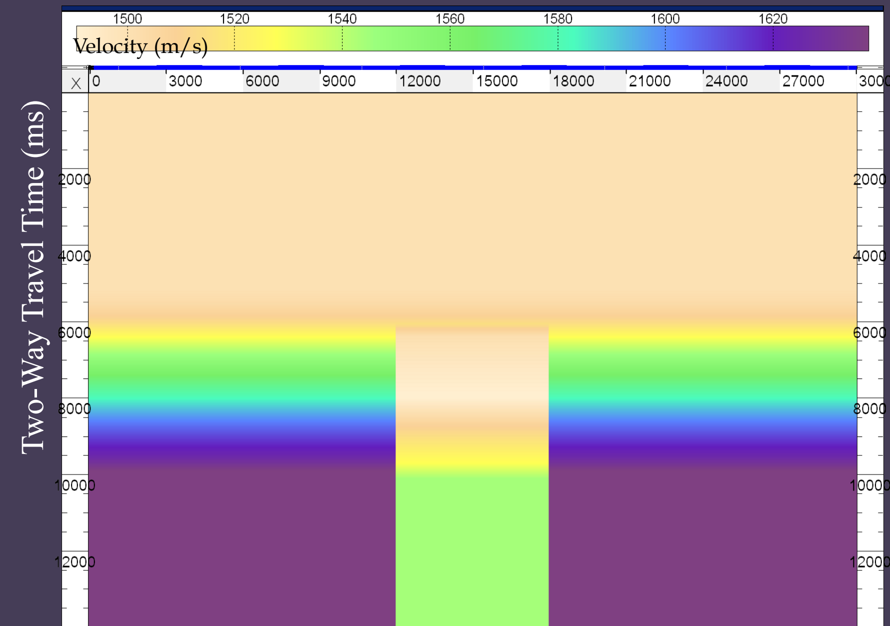
- Seismic evidence from the 1970s led to the discovery of VAMPs in the region.
  - Velocity Anomaly Amplitude Structures
  - Pull-ups and push-downs in the seismic horizons

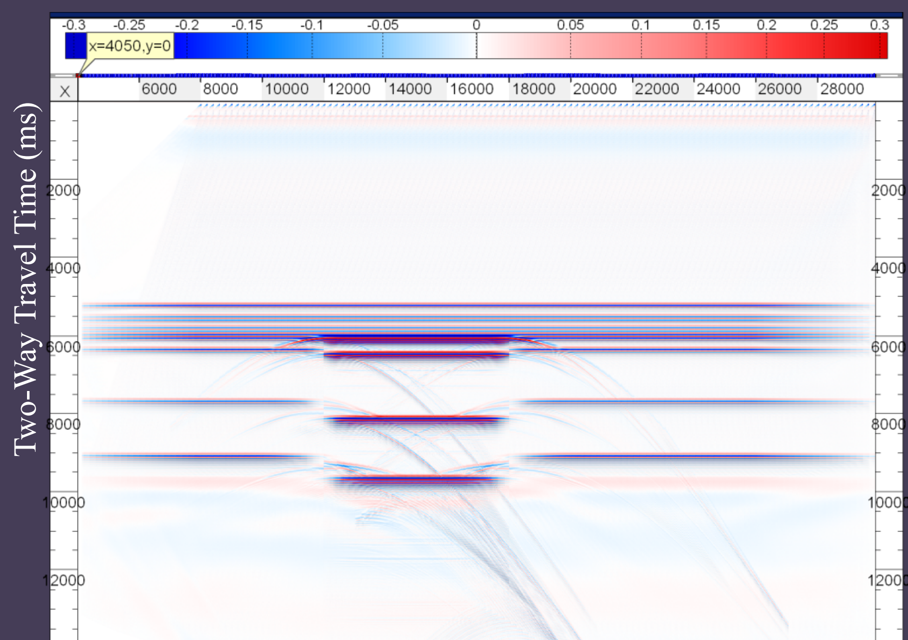
- Interpreted by Scholl and Hart (1993):
  - Methane plumes and gas hydrates (which condense above the plume) are responsible for these anomalies.

Project Outline

- Tesseral Software
  - Construct progressively complex geologic models incorporating a methane hydrate plume.
  - Generate a synthetic seismic section representative of each geologic model.
- Process seismic data from the MGL1111 cruise and compare with the synthetic seismic sections.
- Result: we were able to successfully reproduce the character of the field data.

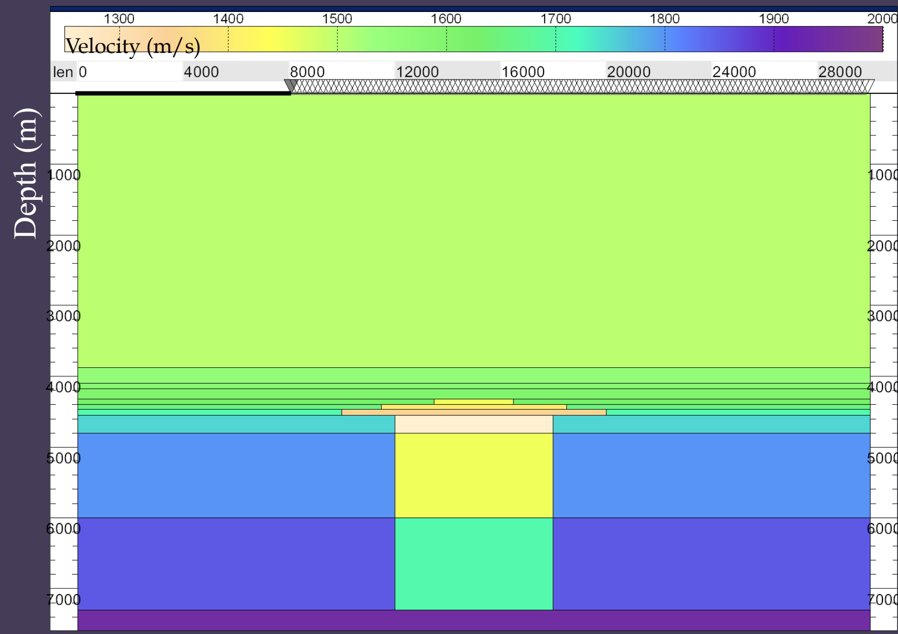


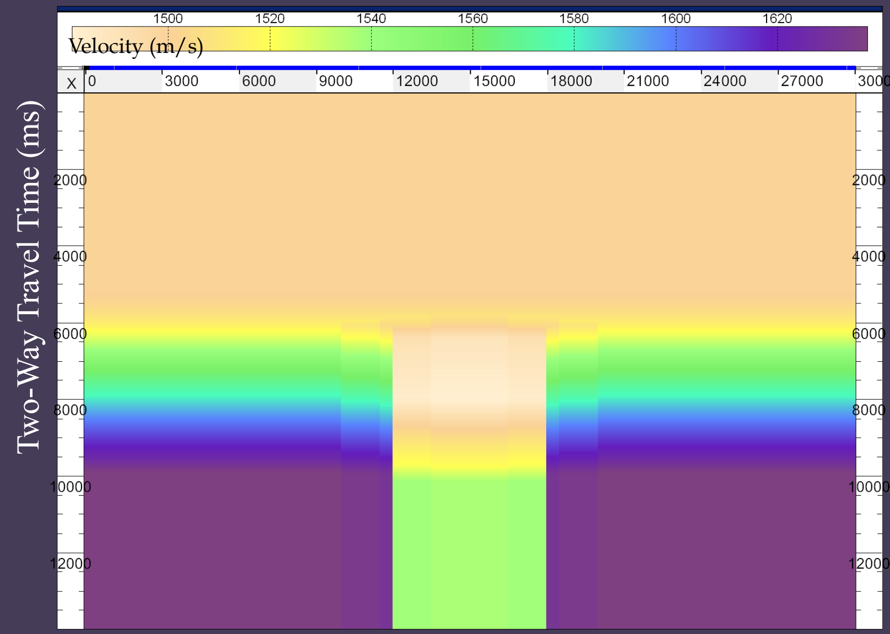


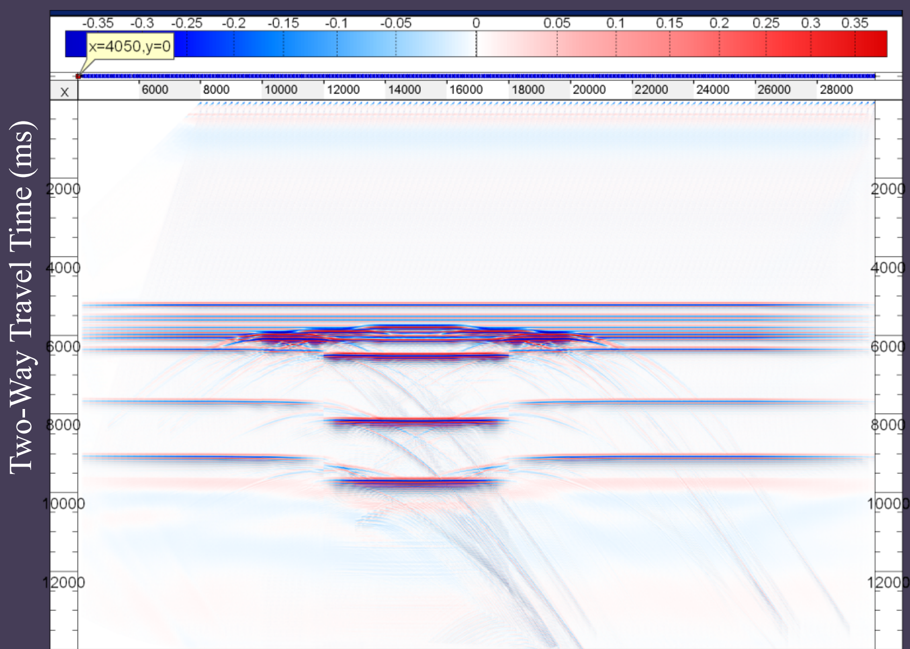


-Geologic model (above left)
-Velocity model (above)
-Generated synthetic seismic section (left)

-This geologic model simply contains three lower velocity layers corresponding to the stem of the methane plume infiltrating the sediment column.
-Velocity pull-downs visible in seismic section.

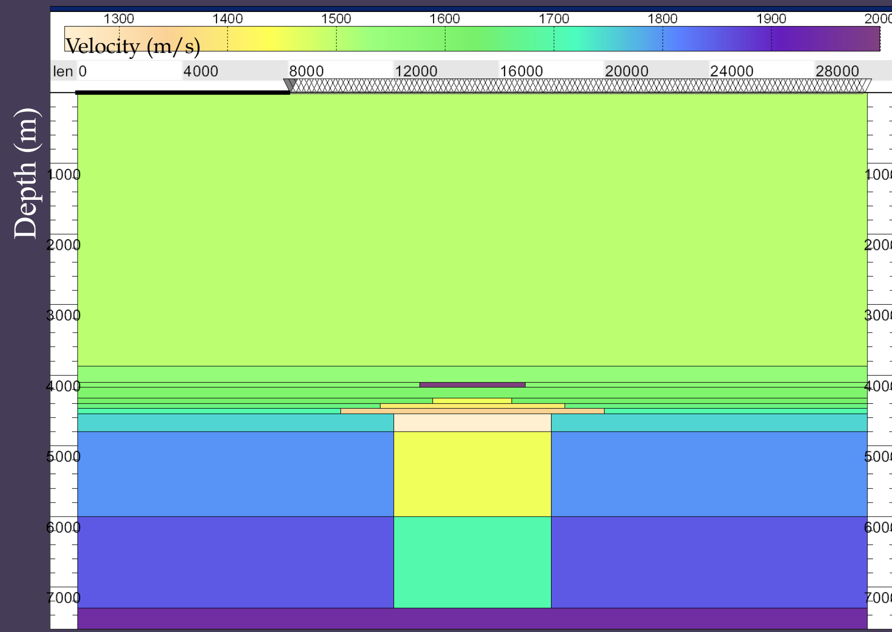


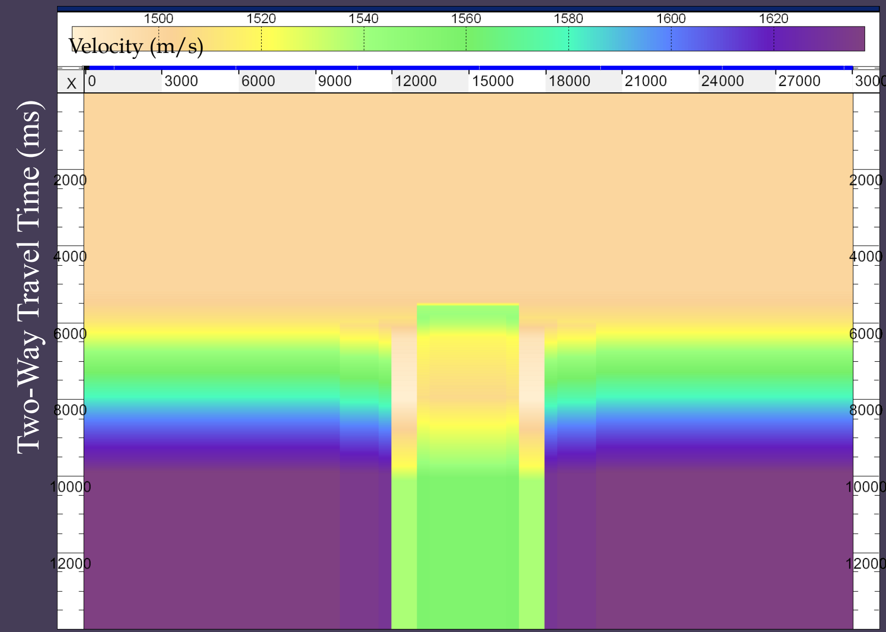


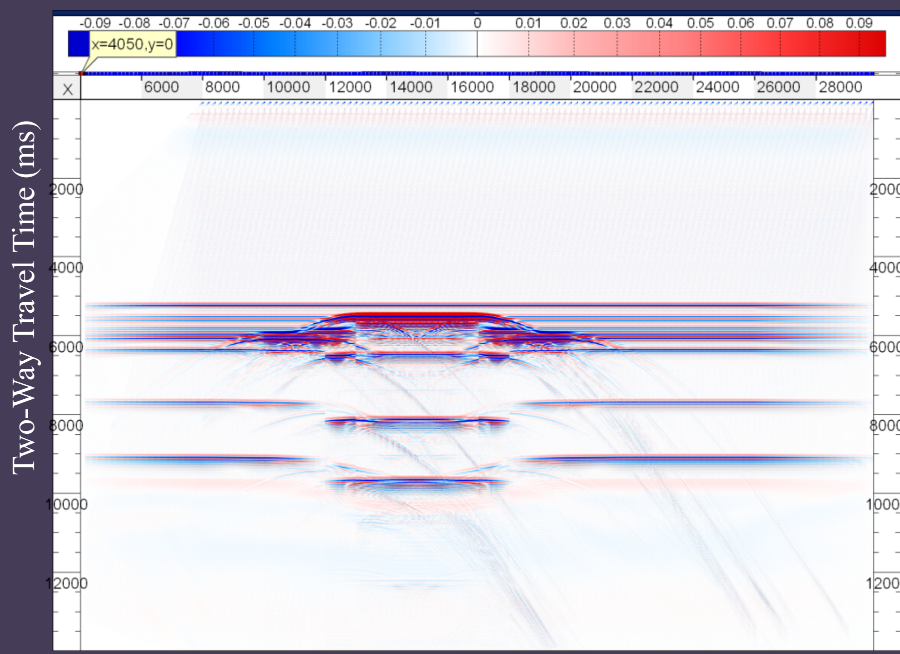


-Geologic model (above left)
-Velocity model (above)
-Generated synthetic seismic section (left)

-This geologic model incorporates a cap over the stem of the plume – consistent with the structure of a typical convective plume.
-Again, velocity pull-downs are visible.

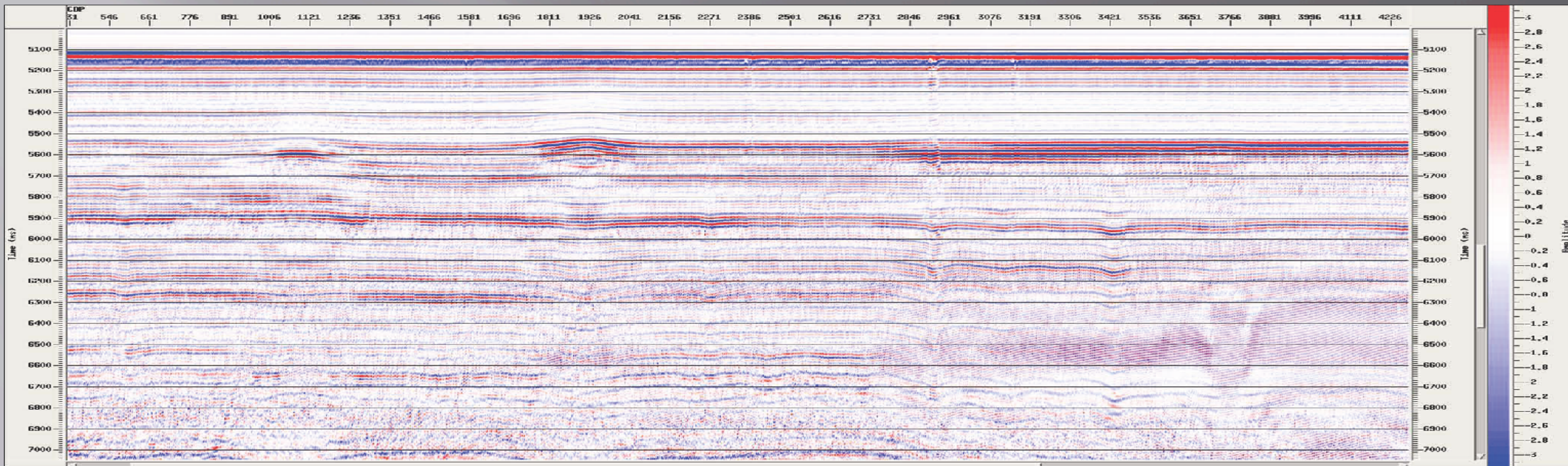


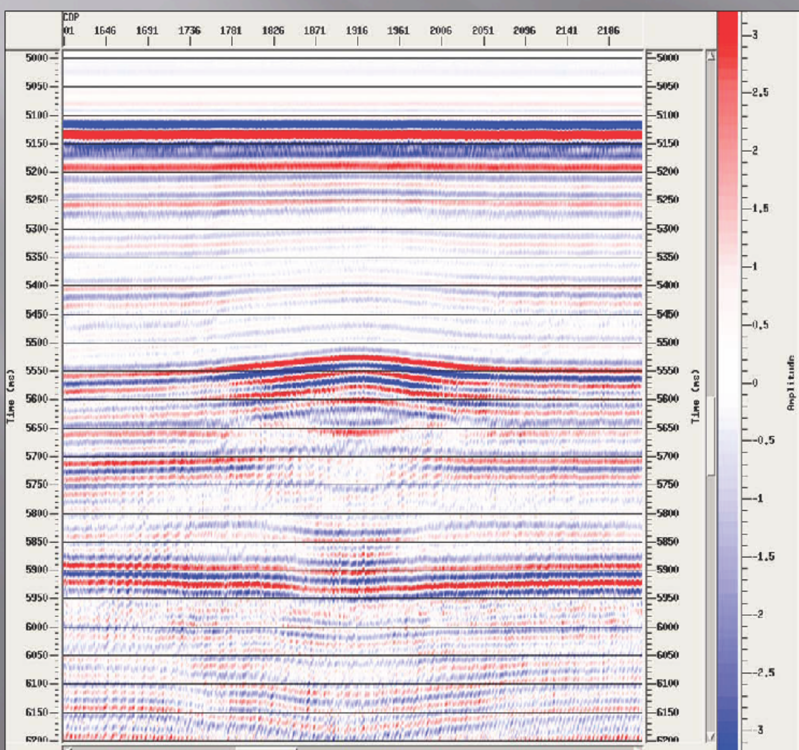


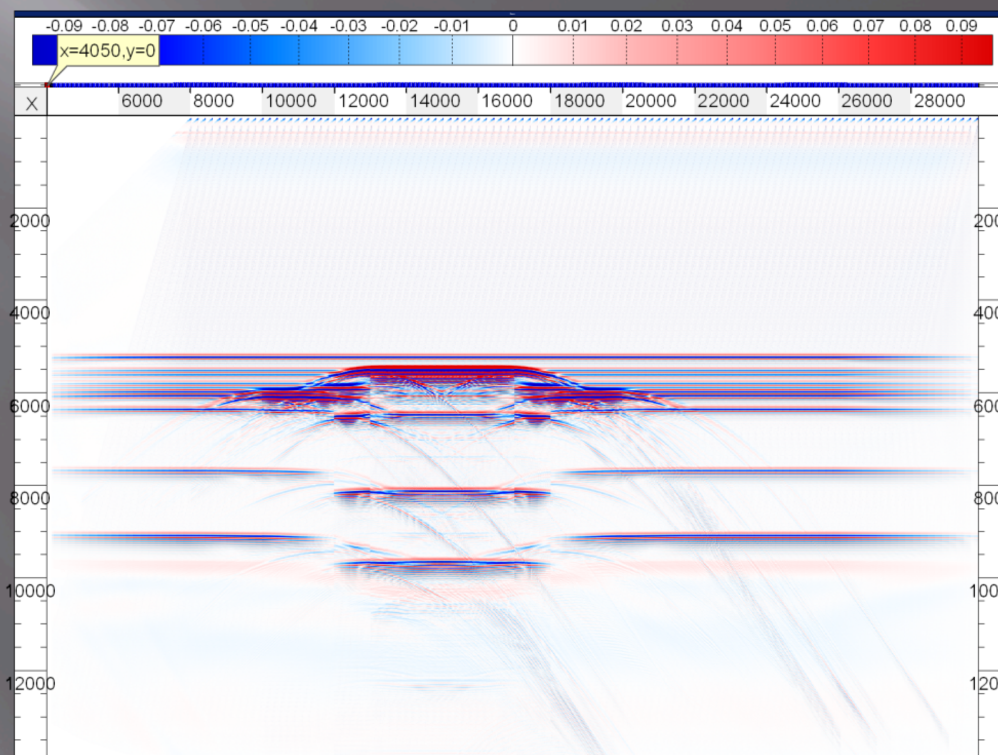


-Geologic model (above left)
-Velocity model (above)
-Generated synthetic seismic section (left)

-This geologic model adds a solid gas hydrate lens with a much higher seismic velocity (3400 m/s).
-Push-downs and pull-ups present in the synthetic seismic section.

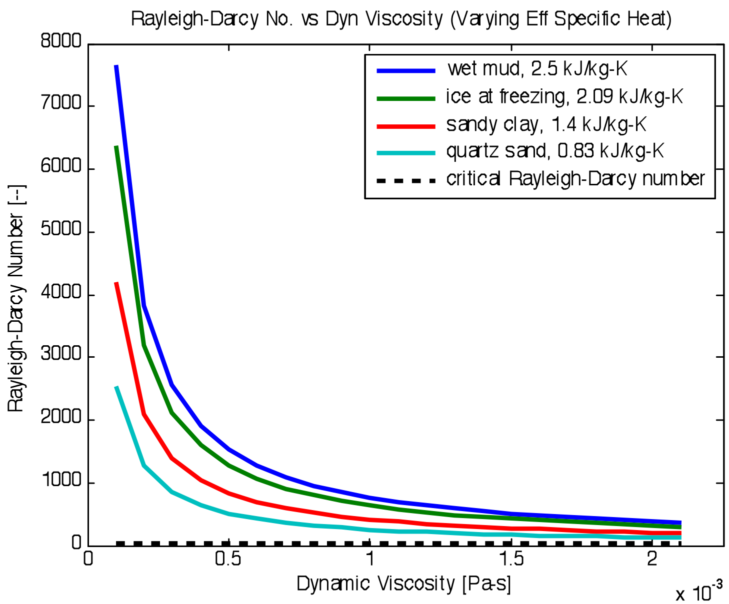


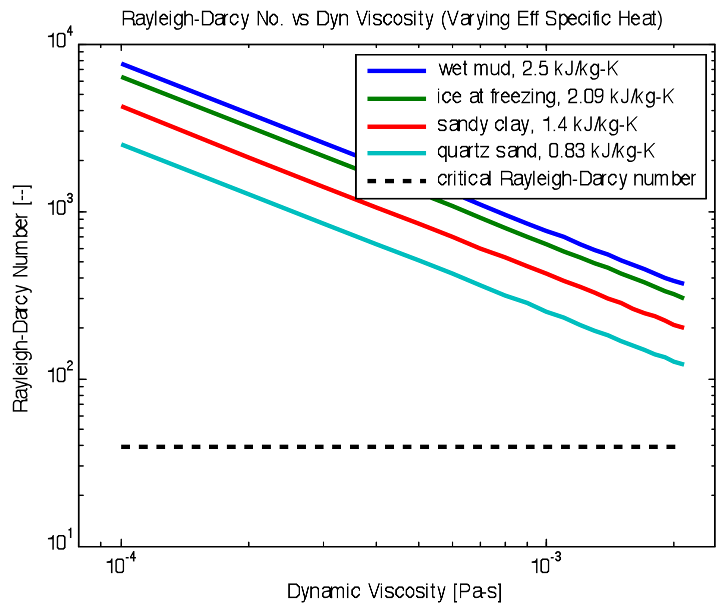




-0.09 -0.08 -0.07 -0.06 -0.05 -0.04 -0.03 -0.02 -0.01 0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09
x=4050,y=0
X
6000 8000 10000 12000 14000 16000 18000 20000 22000 24000 26000 28000
2000
4000
6000
8000
10000
12000

RAYLEIGH-DARCY NUMBER





The Rayleigh-Darcy Number is a non-dimensional parameter that used to evaluate stability in saturated media.

$$Ra_D = \frac{\rho^2 g c_e \alpha |T_1 - T_2| k_h Z}{\mu K_{Te}}$$

$$(Ra_D)_{CR} = 4\pi^2 \cong 40.0$$

denFlu = 1030.0	kg/m3
gravity = 9.80665	m/s2
%effSpHt = 1.381e+3	J/(kg-K)
thermalExp = 244.0e-6	1/K
Tlow = 124.0	deg C
Tupp = 4.0	deg C
permeability = 500.0e-15	m2
depth = 2000.0	m
dynViscosity = 0.282e-3	Pa-s
effThConductivity = 1.0	W/(m-K)